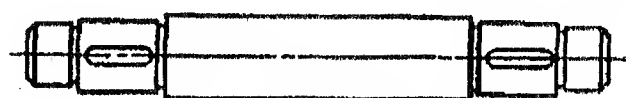
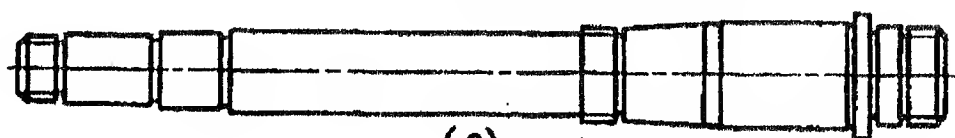


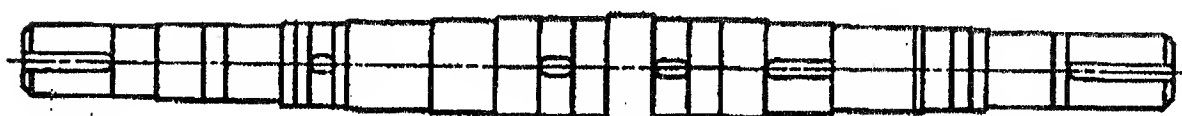
(a) Transition shaft



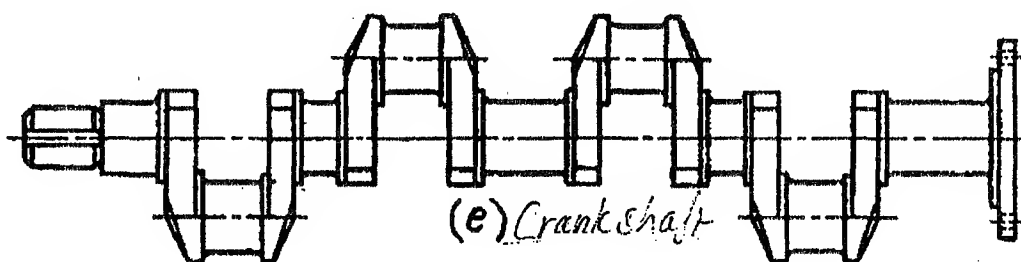
(b) Gear box shaft



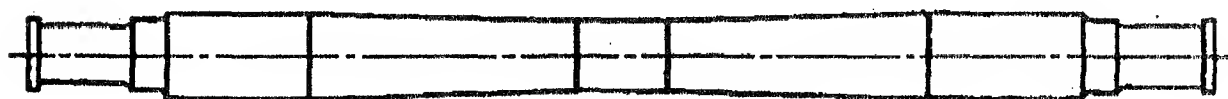
(c) Machine Tool Spindle



(d) Multi stage Turbine shaft



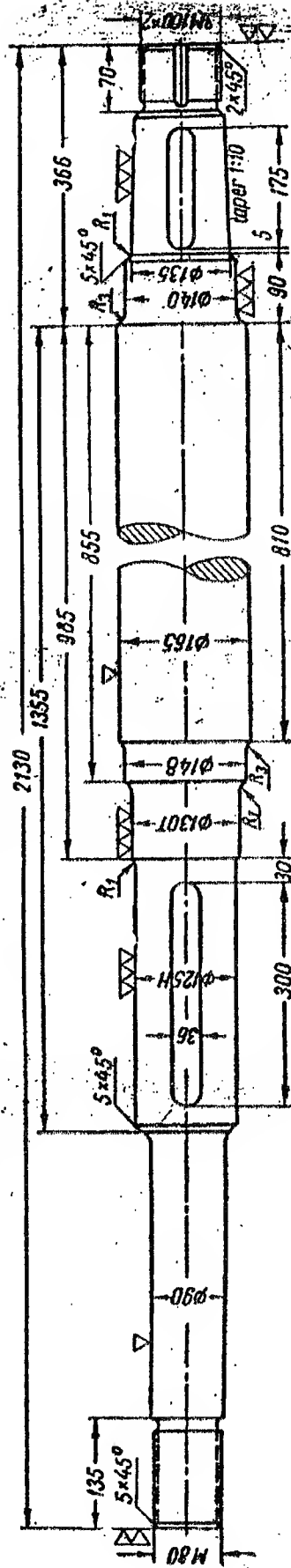
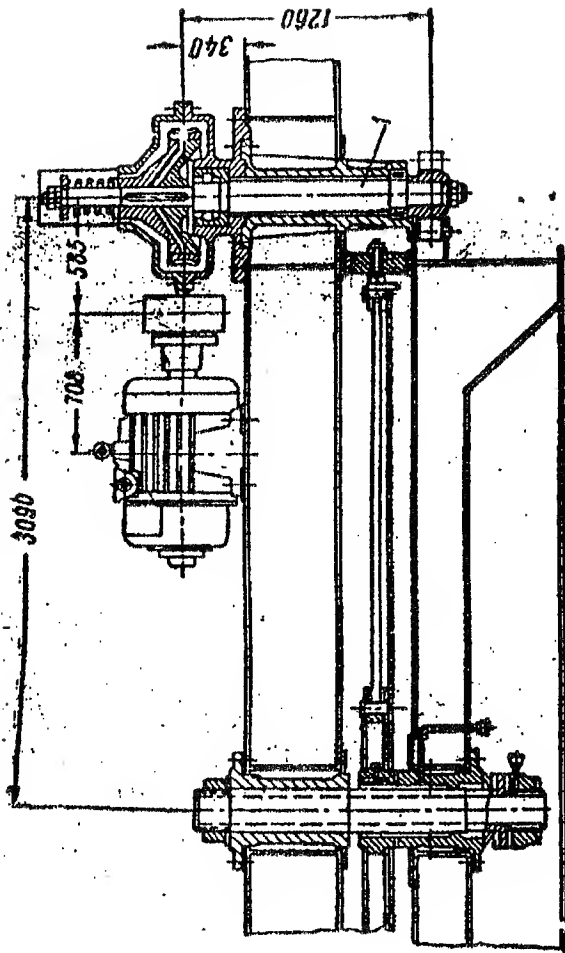
(e) Crankshaft

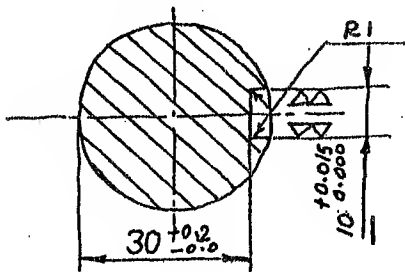
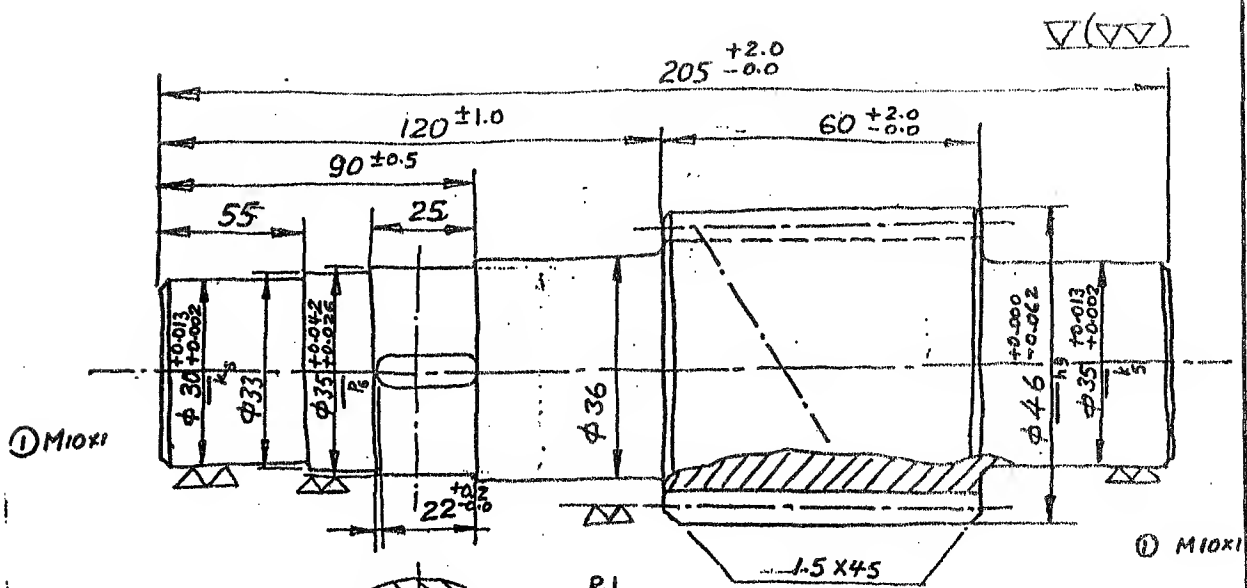


(f) Drive shaft

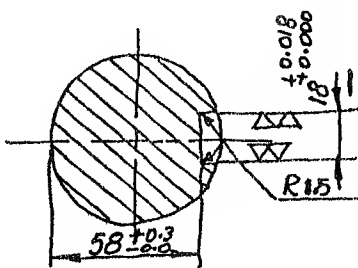
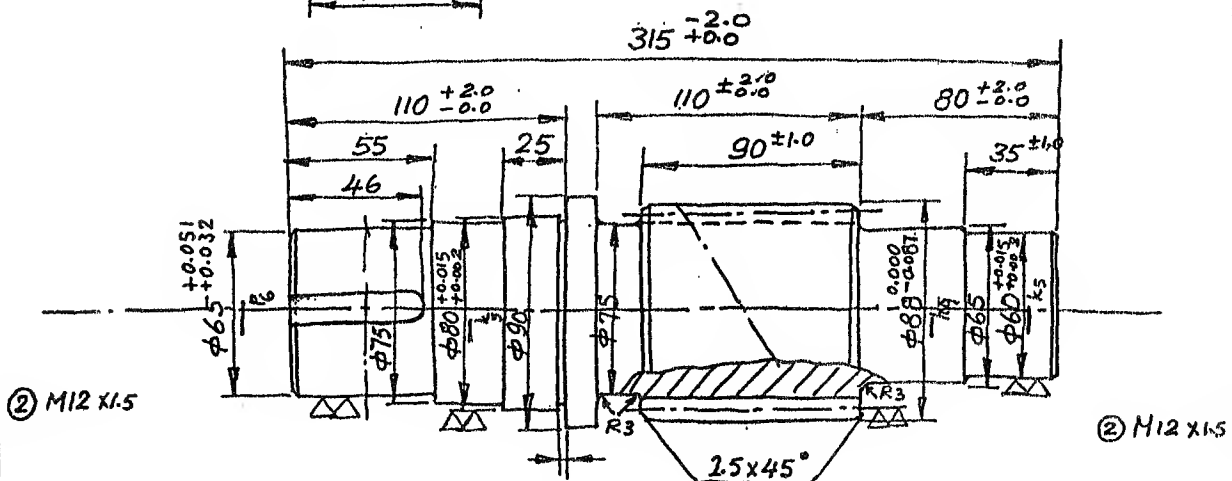


(g) Train shaft



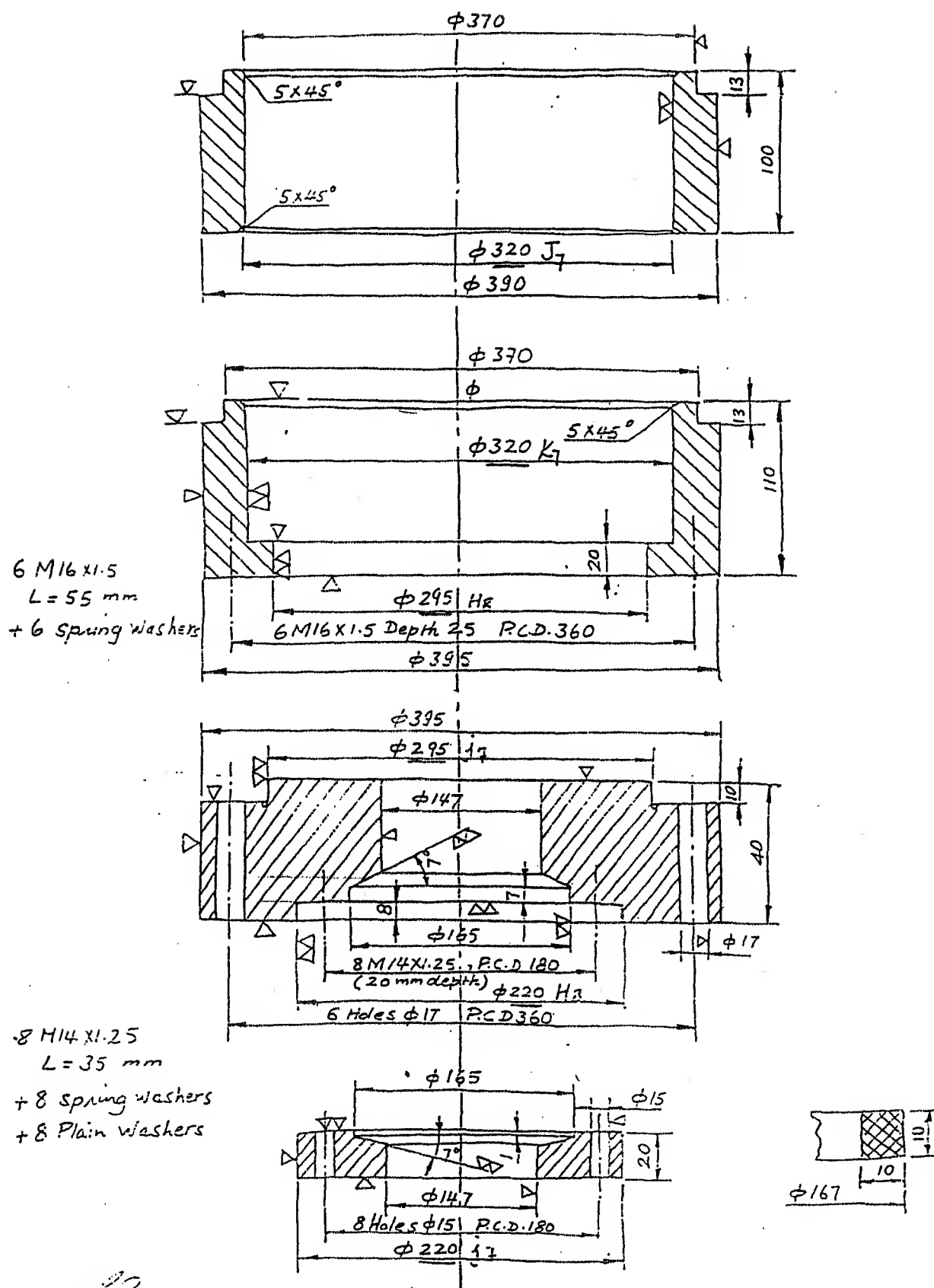


$Z = 19$
 $m_n = 2$ mm
 $\delta = 25^\circ 14' 5''$ (L.H.)
 Depth of tooth = 4.4 mm ✓
 $\alpha = 20^\circ$



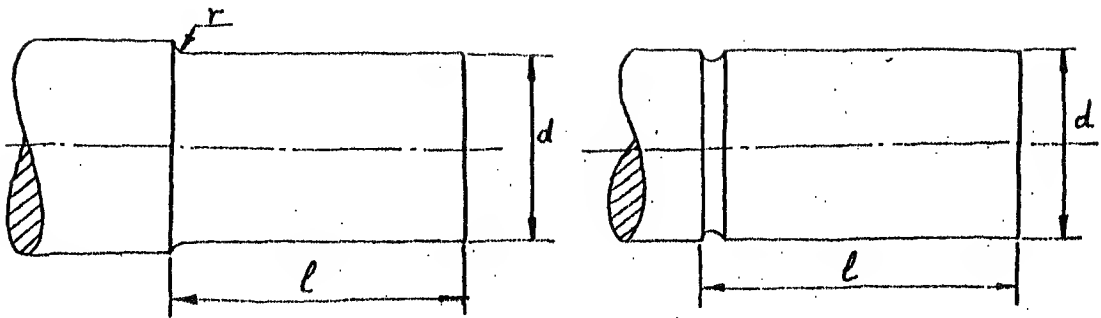
$Z = 19$
 $m_n = 2$ mm
 $\delta = 25^\circ 14' 5''$ (L.H.)
 Depth of tooth = 4.4 mm ✓
 $\alpha = 20^\circ$
 $\delta = 18^\circ 12' 52''$

Non tolerated diam. to be ± 0.2 mm



Shaft end:

1. Straight ends:-

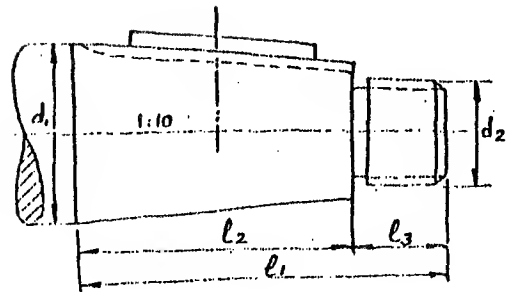
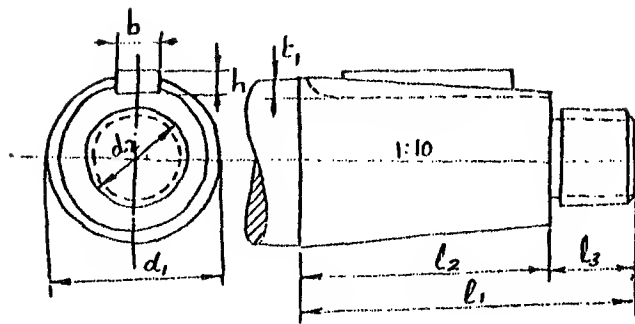


DIN 748 T1 (Jan 1970):

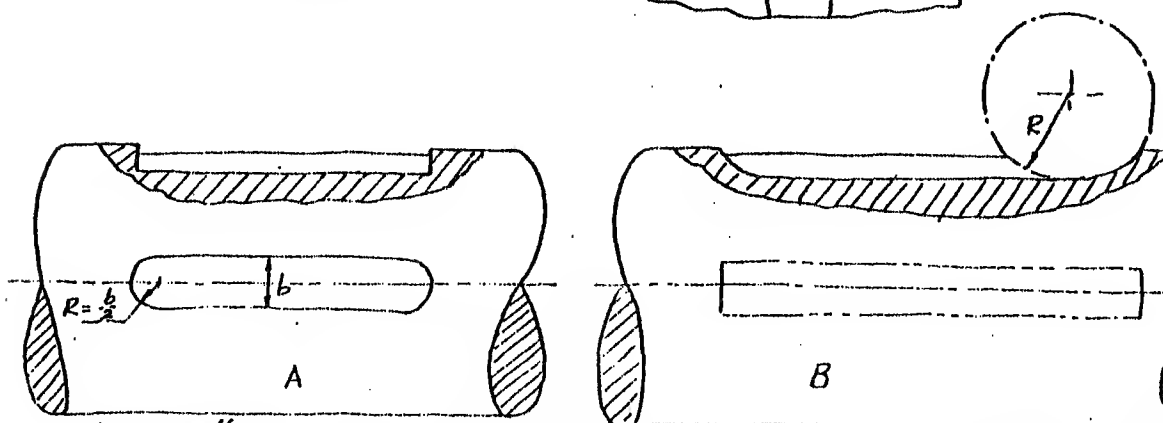
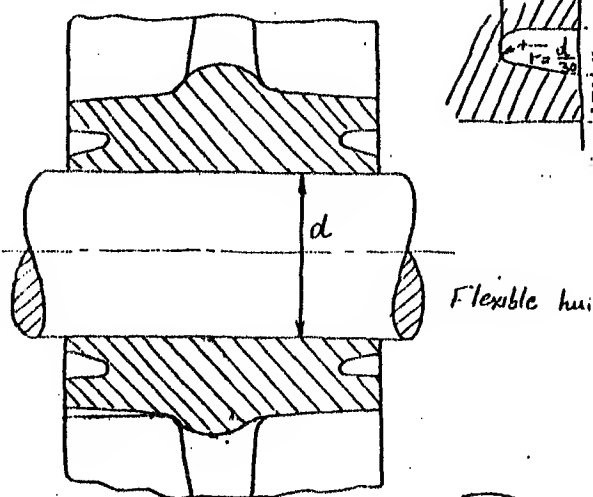
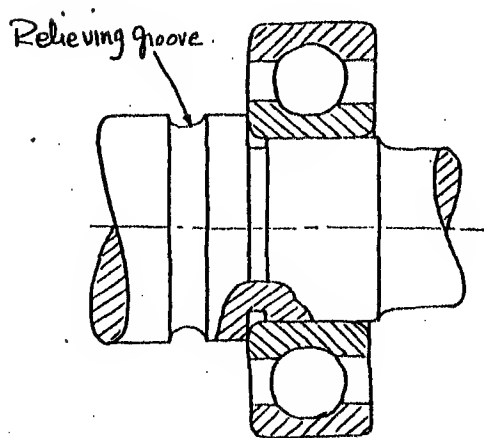
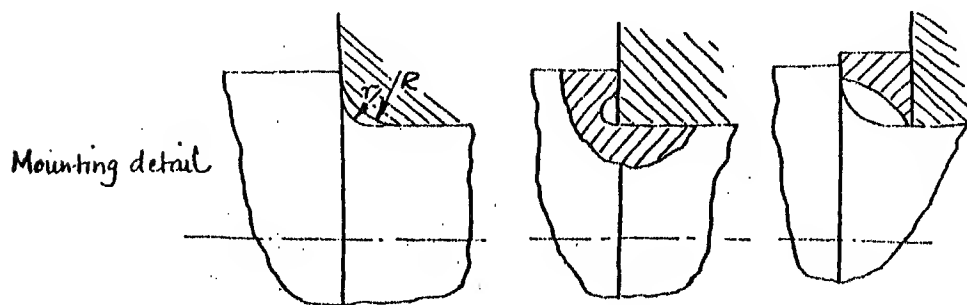
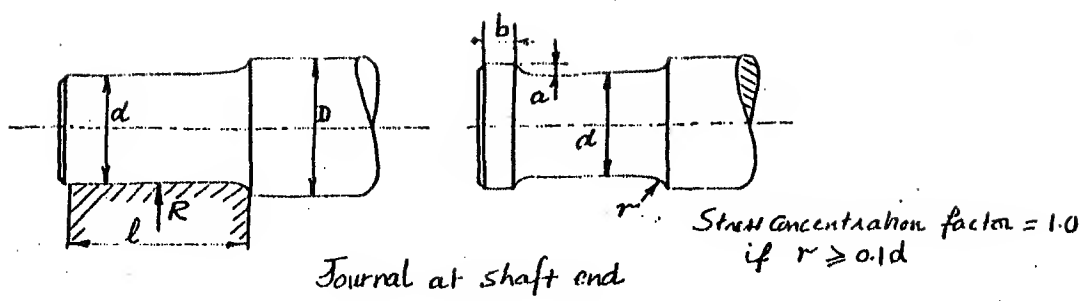
d. mm	16	19	20	22	24	25	28	30	32	35
l. mm	40	40	50	50	50	60	60	80	80	80
	28	28	36	36	36	42	42	58	58	58
r ≤	0.6	0.6	0.6	0.6	0.6	1.0	1.0	1.0	1.0	1.0
d. mm	30	40	42	45	48	50	55	60, 65 70, 75	80, 85 90, 95	100, 110 120
l. mm	80	110	110	110	110	110	110	140	170	210
	58	82	82	82	82	82	82	105	130	165
T ≤	1.0	1.0	1.0	1.0	1.0	1.0	1.6	1.6	1.6 2.5	2.5

1. for end:

DIN 1448 T₁ (Jan 1970)



Shaft diam. d_1 mm.	Thread diam. d_2	l_1		l_2		l_3
		Long	Short	Long	Short	Long or Short
16 19	M10 x 1.25	40	28	28	16	12
20 22 24	M12 x 1.5	50	36	36	22	14
25 28	M16 x 1.5	60	42	42	24	18
30 32 35	M20 x 1.5	80	58	58	36	22
38 40 42	M24 x 2	110	82	82	54	28
45 48	M30 x 2					
50 55	M36 x 3					



Keyway effect:
Stress concentration in B is 30% less
than that in A.

DIN 509:1977
 in all cases the latest German-language version of this standard shall be taken as authoritative
 Nachdruck, auch auszugsweise, nur mit Genehmigung des DIN Deutsches Institut für Normung e. V., Berlin 30, gestattet
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 Henry C. F. & Co., Düsseldorf
 Alleinvertreter der Normen durch Beuth Verlag GmbH, Berlin 30 und Köln 1

Undercuts

DIN
509

Freistriche

From size 0.6 x 0.2 upwards, undercuts of Type E and F can be produced by copying methods. For details of earlier Types A, B, C and D (not to be used for new designs), see page 3.

Dimensions in mm

The dimensions given in the Tables apply to the finished component. The illustrations show outside undercuts on turned parts.

Type E for workpieces with one machined surface

Type F for workpieces with two machined surfaces at right angles to each other

z = Machining allowance
 d_1 = Finished dimension

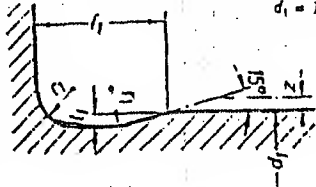


Figure 1

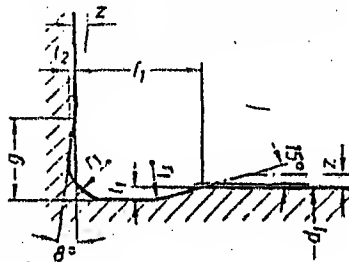


Figure 2

Designation of an undercut of Type E of radius $r_1 = 0.6$ mm and depth $t_1 = 0.2$ mm:
Undercut E 0.6 x 0.2 DIN 509

Table 1

r_1	t_1	r_1	g	t_1	reproduc- ible by copying	recommended correlation to diameter d_1 for workpieces for normal duty conditions	with increased fatigue resistance
0.1	0.1	0.5	0.8	0.1	no	to 1.6	—
0.2	0.1	1	0.9	0.1		above 1.6 to 3	
0.4	0.2	2	1.1	0.1		above 3 to 10	
0.6	0.2	2	1.4	0.1	yes	above 10 to 18	—
0.6	0.3	2.5	2.1	0.2		above 18 to 80	
1	0.4	4	3.2	0.3		above 80	
1	0.2	2.5	1.8	0.1	yes	—	above 18 to 50
1.6	0.3	4	3.1	0.2			above 50 to 80
2.5	0.4	5	4.8	0.3			above 80 to 125
4	0.5	7	6.4	0.3			above 125

Finish: $\nabla\nabla$, alternative surface qualities are to be specially indicated in the designation, e.g.
Undercut E 1 x 0.2 DIN 509 - $\nabla\nabla\nabla$

¹⁾ The correlation to various diameter ranges does not hold good when short projections and thin-walled parts are involved.
When a workpiece has different diameters, it may be convenient for production reasons to use the same shape and size of runout at several points.

For undercuts for screw threads, see DIN 76

For blending features as fitting dimensions for ball and roller bearings, see DIN 5416

Continued on pages 2 and 3
Explanations on page 4

DIN 509 engl. Freiegr.
Verz. 40, 010

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877

Countersink in the companion part

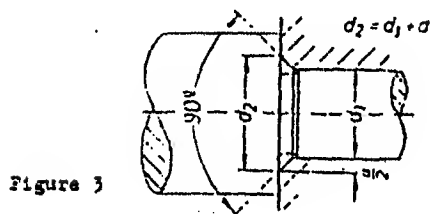


Figure 3

Table 2

Undercut size $r_1 \times l_1$	a Maximum Type	
	E	F
0,1 x 0,1	0	0
0,2 x 0,1	0,2	0
0,4 x 0,2	0,4	0
0,6 x 0,2	0,8	0,2
0,6 x 0,3	0,6	0
1 x 0,2	1,6	0,8
1 x 0,4	1,2	0
1,6 x 0,3	2,6	1,1
2,5 x 0,4	4,2	1,9
4 x 0,5	7	4,0

Effect of machining allowance on Type E and F

The machining allowance z displaces the blend of the undercuts into the machined surfaces by the amount e_1 and e_2 respectively.

This amount depends on the size of the machining allowance z and on the entering and leaving angles at the undercut.

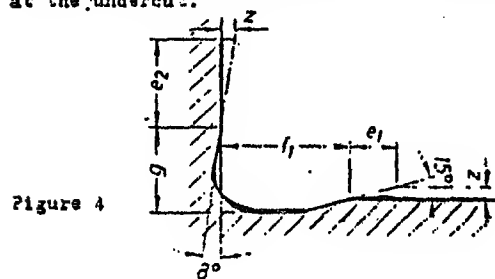


Figure 4

Table 3

z	e_1	e_2
0,1	0,37	0,71
0,15	0,54	1,07
0,2	0,71	1,42
0,25	0,88	1,78
0,3	1,12	2,14
0,4	1,49	2,85
0,5	1,87	3,56
0,6	2,24	4,27
0,7	2,61	4,98
0,8	2,99	5,69
0,9	3,36	6,40
1,0	3,73	7,12

Method of representation and detailing of undercuts in drawings

Undercuts shown in drawings can either be drawn in full and dimensioned or shown in simplified form with the appropriate designation.

Example: Undercut Type F
of radius $r_1 = 1$ mm and
depth $t_1 = 0,2$ mm

Example: Undercut Type E
of radius $r_1 = 1$ mm and
depth $t_1 = 0,2$ mm

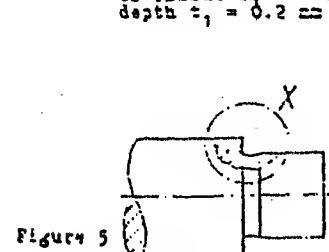


Figure 5

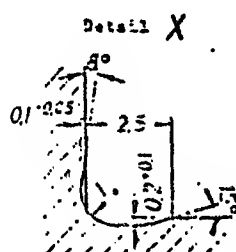


Figure 6

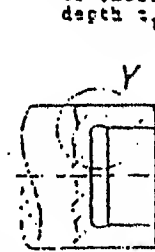


Figure 7

F1=0,2 DIN 509

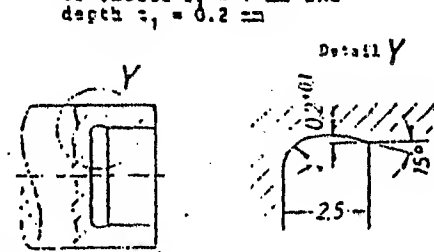


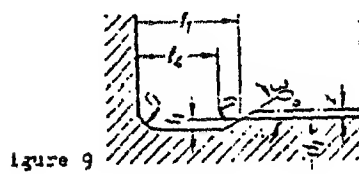
Figure 8

E1=0,2 DIN 509

Undercuts of Type A and B are not to be used of new designs. As they are not reproduced by copy methods, they have to be made by means of form tools. The dimensions of these types are given here because they are referred to in existing production documents.

Type A for workpieces with one machined surface

Type B for workpieces with two machined surfaces at right angles to each other



z = Machining allowance
 d_1 = Finished dimension

Figure 9

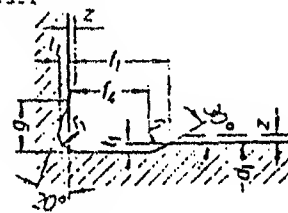


Figure 10

Designation of an undercut of Type B of width $l_1 = 4$ mm and depth $t_1 = 0.3$ mm:
Undercut B 4 x 0.3 DIN 509

Table 4

l_1	t_1	Perf. var.	l_2	g	r_1
1	0,1	+0,05	0,8	0,5	0,2
2	0,2	+0,1	1,5	1	0,4
4	0,3		3,3	1,5	0,6
6	0,4		5	2,3	1

Type C for workpieces with one machined surface

Type D for workpieces with two machined surfaces at right angles to each other

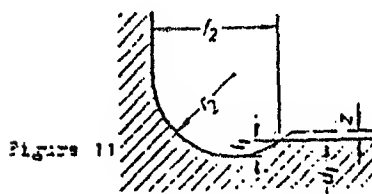


Figure 11

z = Machining allowance
 d_1 = Finished dimension

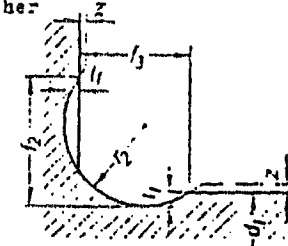


Figure 12

Designation of an undercut of Type C of radius $r_2 = 1$ mm and depth $t_1 = 0.2$ mm:
Undercut C 1 x 0.2 DIN 509

Table 5

r_2	t_1	l_2	l_3
1	0,2	1,6	1,4
1,6	0,3	2,5	2,2
2,5	0,3	3,7	3,4